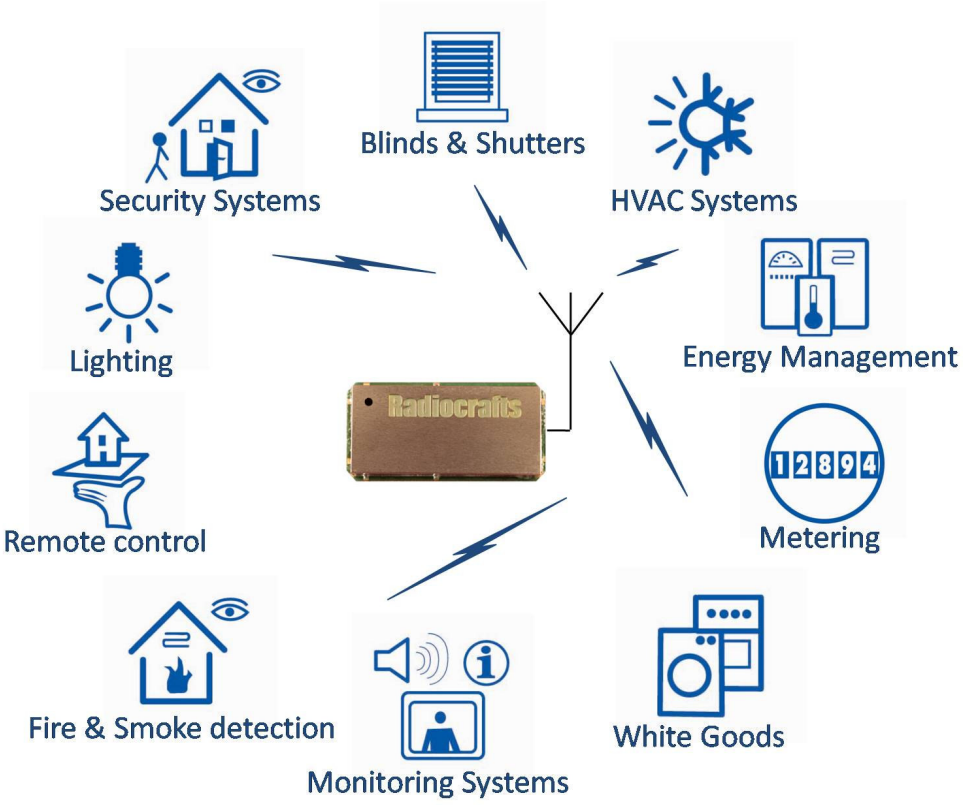
KNX User Manual



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Quick Introduction

How do I transmit data?
Send your data to the RXD pin on the module. Use the UART format with settings (19200, 8, 1, N, no flow control). Up to 255 bytes are buffered in the module. The first byte of the message should contain the message length. The module will transmit the data when the whole packet is received.

How do I receive data?
Any received data packet with correct KNX-RF format and check sums will be sent on the TXD pin. Optionally the meter address (first KNX block) is added to the data string. The RSSI value (received signal strength) can optionally be added to the message.

What about the antenna?
In most cases a simple quarter wavelength wire or a PCB track will do. Connect a piece of wire to the RF pin with length corresponding to the quarter of a wavelength. For space limited products, contact Radiocrafts and we will recommend the best antenna solution for your application.

How do I change the operating mode or any other parameter?
To change configurable parameters, send one byte to the module with the value 0x00. This will take the module into configuration mode. Special commands are then used to access the configuration registers and test modes. Exit from configuration mode by sending the 'X' command. Parameters can be changed permanently and stored in non-volatile memory in the module.

KNX feature sets

This User Manual describes the embedded protocol of the KNX Modules from Radiocrafts. The KNX firmware is available as different feature sets targeting specific applications. The hardware platform is the same for all solutions, and the different feature sets available are listed in the table below. Detailed information on how to use the different feature sets is found in this User Manual.

There are four KNX RF specifications:

- KNX RF Ready is a single channel system at 868.3 MHz, and is an update of KNX RF revision 1.1 specified in EN 50090-5-3:2006
- KNX RF Multi is a multichannel evolution of KNX RF Ready system with to additional RF channels for fast reaction time products and two RF channels for slow reaction time products
- KNX BiBat is a system for synchronised products based on KNX 1.1 specification
- KNX BiBat 2 is an evolution of BiBat with two RF channels based on KNX 1.1 specification

For additional information about the KNX RF packet structure, please see EN 50090-5-3:2006, and KNX System Specifications part 3.2.5, Communication Media, Radio Frequency.

Feature List	Feature set		
	KNX1	KNX2	KNX3
General	Basic KNX-RF 1.1 and KNX Ready functions	TBD	TBD
Network role	Sender and Receiver		
KNX packet handler	Yes		
Modes	S1, S2		
Addressing	Serial and domain addressing		
Number of installed serial number	Up to 64		
Filter function	Receiver only receives messages from installed/registered group addresses		
Listen before talk (LBT)	Yes, according to KNX		

The command set used to configure the KNX modules are different for each feature set and an overview is found in the appendixes.

Note that this User Manual also is applicable for the RCxxxxTX-KNX (planned future product). This is a TX only hardware and the RX features described in this User Manual is not supported.

Optional custom specific version

As an option to the standard feature sets, a full KNX application layer can be integrated in the module based on customer specification. In this case all the application layer protocol and timing will be handled internally by the module. See Data Sheet for details.

Network Topology

A KNX based building automation system normally consists of a number of sensors which reports their readings and status to a concentrator for further processing, or directly trigging actuators. The network topology is one-to-many or peer-to-peer. KNX-RX 1.1 or KNX RF Ready does not use the Master – Slave concept of for example Wireless M-Bus. Several receivers can receive the same message based on registering the group (or individual) address of the transmitter.

The Radiocrafts KNX-RF family of modules RC11xx-KNXx can be used as transmitters or receivers. The module is configured with a unique address (Serial Number), and a Domain Address, and when sending a reading or command this address is added to the wireless message. Up to 64 transmitter addresses (the 6 bytes of the extended address) can be registered in the receiver, which will filter messages from only these transmitters.

Sensors being transmitters only can be battery operated as they can by set in sleep mode when not transmitting. For two-way battery operated systems, the new KNX BiBat (Bi-directional Battery operation) specification applies.

A re-transmitter can be used to increase the range of the RF system. Messages from transmitters that have been registered in the re-transmitter will be re-transmitted.

KNX-RF Embedded Protocol

Basic functionality
The module offers a buffered packet radio acting as a KNX modem. The module contains a fully embedded protocol supporting:

- Unidirectinal devices (transmit only, S1)
- Bi-direction devices (S2)

The mode is configurable by the KNX_MODE parameter.

The required KNX mode is configured by setting the module in configuration mode and entering appropriate UART commands.

S2-mode:
Set KNX_MODE = 0
Set PREAMBLE_LENGTH = 0 (for short preamble) or 1 (for long preamble).

S1-mode:
Set KNX_MODE = 3
Set PREAMBLE_LENGTH = 0 (for short preamble) or 1 (for long preamble).

KNX Ready use the long preamble, while KNX RF 1.1 use short preamble.

The RF channel (868.3 MHz) and data rate (32.768 kchip/s) are set internally in the module according to S mode.

The module has an internal buffer and transmits application data after the whole packet is received based on the packet length (first byte of the application frame). The module use Listen Before Talk (LBT) to avoid collisions. The module will listen for a preamble for 15-30 ms (at random) and only transmit if the channel is free. If a preamble is detected, the module will wait until that message has been completed, and will then again listen for a new preamble for another 15-30 ms (at random), until the channel is free.
Optionally (configurable) the module will send a “Transmission complete” message (“Length = 00h, followed by 3Fh) on the UART when the transmission has been done.

For uni-directional devices (S1 transmit only), data should not be sent to the module more frequent than every 150 ms. The data packets should also have a random spacing of 0-10 ms (or more).

The module also has a timeout feature that will empty the input buffer in case of false data packets. The default timeout is 2 seconds. Max total payload is 246 bytes, or 255 including the header in the first block.

Sleep mode can be entered via an UART command and wake-up is triggered on UART traffic (one FFh byte). Sleep mode can also be entered automatically after a transmission (configurable by SLEEP_MODE) when using the S1 (transmit only) mode.

The module acts as a buffered packet radio, hence all data to be sent is stored in the module before they are transmitted by the RF circuitry. Likewise, when data is received they are stored in the module before they are sent to the host. This allows the communication controller to add address information and CRC during transmission, and to do error check of the received data.

The Module has an UART interface that is used for both KNX-RF packet data and module configuration.

UART Interface for KNX-RF packet handling

The KNX-RF frame format follows the FT3 block format, using two CRC bytes for every 16 data bytes. This ensures the high integrity of the data link.

The KNX modules include a KNX packet handler that with automatic generation of Preamble (Header + synchronization), Block 1 (C-filed, RF-info and address), CRC and Postamble. This will simplify the UART format for the host controller that only need to provide application layer data to the module UART.

The host use the UART Interface to send and receive KNX-RF data. The UART packet format can be changed in the configuration mode.

When the Module receives a KNX packet over RF it will send the packet over the UART interface on the TXD Line. When the host MCU wants to transmit a KNX packet over the RF, it must send the packet through the UART Interface on the RXD line.

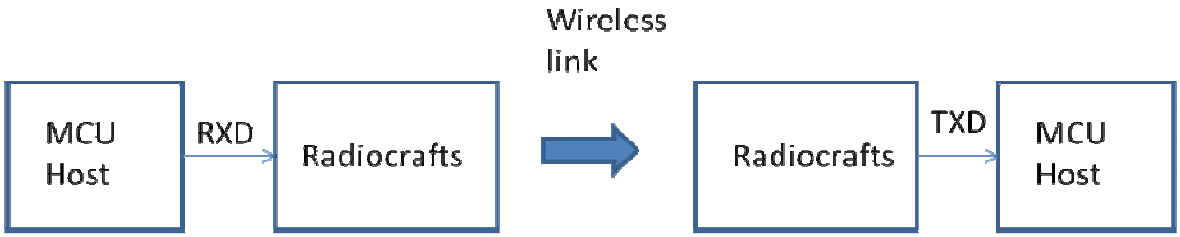

Figure 1: UART interface overview and KNX RF packet format

Frame format for transmitting data
The data frame for the UART RXD pin (input for transmitting a KNX packet) is built like this:

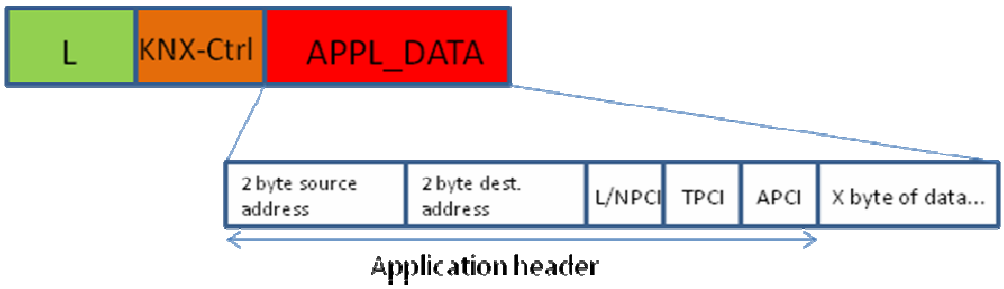

Figure 2: UART interface packet transmission (RXD pin)

L is the length (not including the length byte itself), followed by the data headers with the CI byte first. CI is the Control Information byte (or "KNX-Ctrl"). The data headers are L/NPCI (Link/Network Protocol Control Information), TPCI (Transport layer Protocol Control Information) and APCI (Application layer Protocol Control Information).

The C-field is fixed to 44h (i.e. SND-NR message). The RF-info contains battery status, which can also be added by the module based on a configurable voltage threshold (BATTERY_THRESHOLD) which can be set in 30mV steps. The maximum value is 3.75V corresponding to 7Fh.

The unique Serial Number (SN) and Domain Address (DoA) are entered and stored in the modules' non-volatile memory. Depending on the Application header AET bit in the L/NPCI field either the SN or DoA will be used.

The Link layer header (L, C-field, RF info and address) is added to the KNX packet automatically by the module before transmitting over RF. Compared to the KNX frame used for wired communication like twisted pair, an extended address is used. This is to avoid conflicts between two adjacent networks. The Group addresses (source and destination address) is coded in the beginning of the application header.

By setting DATA_INTERFACE = 0x10 (or in combination as 0x11 – 0x1C), the two byte string 00:3Fh (i.e. L = 0) will be sent on the UART when transmission is completed (after LBT).

Frame format for receiving data
The data frame for the UART TDX pin (Output for received KNX packets) is built like this:

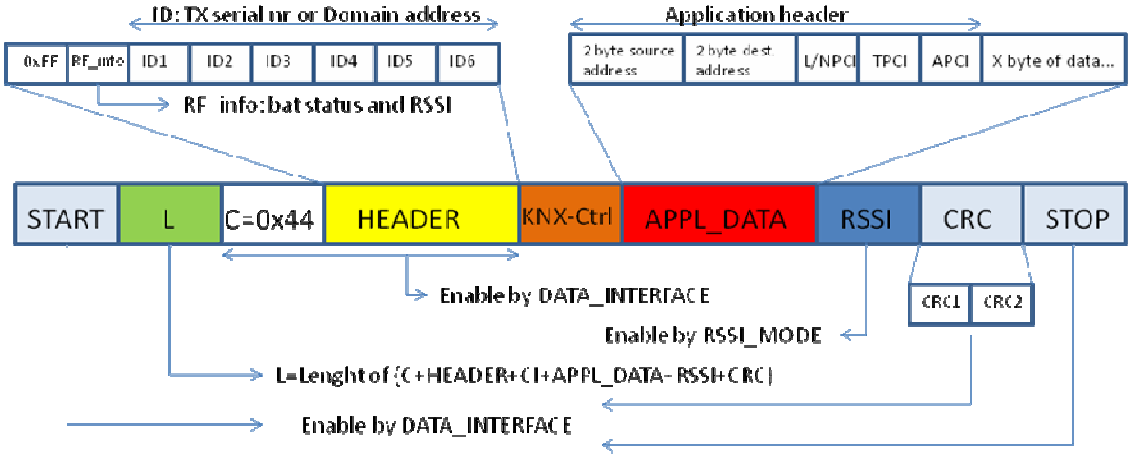

Figure 3: UART interface packet reception (TXD pin)

Data in blue and yellow are optional output parts of the UART message and can be enabled in configuration mode by the DATA_INTERFACE and RSSI_MODE configuration parameters.

L is the length byte and is always present. It does not include itself or the START/STOP bytes, but will include RSSI and CRC if enabled.

Do also note that the receiving module will add RSSI information within the RF-info byte, based on received signal level.

When setting DATA_INTERFACE = 1, the received HEADER will not be sent on the UART.

For host applications using a UART buffer the timing information used for parsing could be lost. In this case a start and stop byte can be used. Setting DATA_INTERFACE = 4 will add a START byte (68h) and a STOP byte (16h) to the message. This is only used for the module-to-host communication direction (TXD). Setting DATA_INTERFACE = 8 will add a two byte CRC checksum, and DATA_INTERFACE = 0Ch will add START/STOP bytes and CRC. The CRC is sent MSByte first.

The RSSI value is added when RSSI_MODE = 1.

UART Interface for Module Configuration

The configuration of the module can be changed in-circuit from the host during operation, at the time of installation of the equipment, at the manufacturing test, or even as a stand-alone module. The configuration is changed by sending commands on the UART interface after the module is set in configuration mode. The configuration mode is entered by sending 00h to the module, or by asserting the CONFIG pin (set low).

In configuration mode the module will respond by sending a '>' prompt on the TXD pin. This indicates that the module is ready to receive commands. The CONFIG pin (if used) can then be de-asserted. Note that the CONFIG pin must be de-asserted *before* the Exit command ('X') is sent to the module in order to return to normal operation.

After a command is executed, the module responds with the '>' prompt character again, indicating it is ready for a new command. Do not send a new command before the '>' prompt is received. The time required to execute a command can vary depending on the command (see the Timing Information section). There is no '>' prompt after the 'X' exit command.

The parameters that are set by dedicated configuration commands ('C', 'P' etc) take immediate effect after returning to normal operation (IDLE), but will not be stored in non-volatile memory and will be lost in case the supply power is turned off or if the module is reset. These parameters are for example the radio channel and output power.

Permanent changes of parameters can be done by writing to the configuration memory using the memory command 'M'. These are for example *default* radio channel, *default* output power and M-Bus mode, see the Configuration Memory section for details.

The flow diagram bellow illustrates how to use the UART interface to enter configuration mode, change configuration parameters and return to IDLE mode.

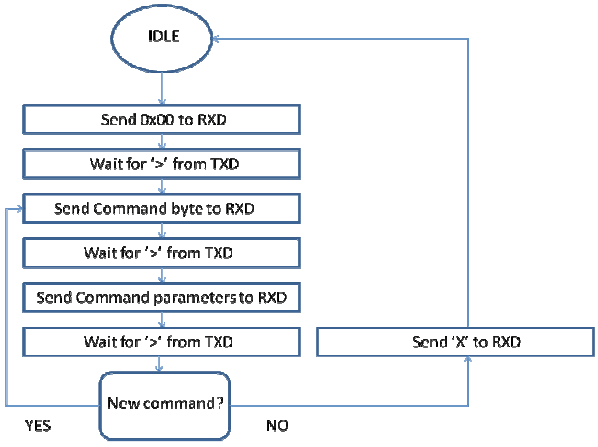

Figure 4: Configuration mode flow diagram

UART Timing Information
A UART byte consist of one start bit, 8 data bits, and one stop bit. In configuration mode a command to prompt reply will looks like this:

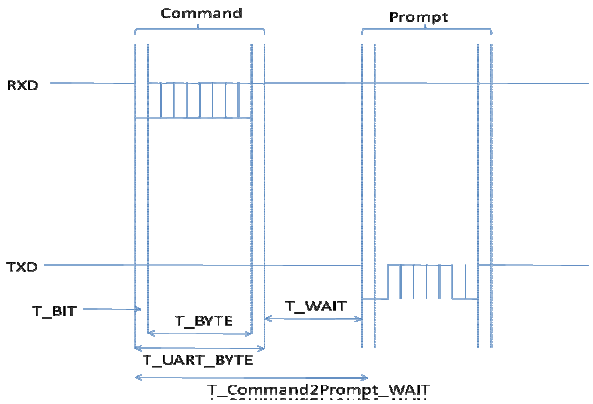

Figure 5: UART Command and prompt

The command-to-prompt wait time (T_Command2Prompt_WAIT) is different from command to command and values are shown in the timing table for each KNX feature set.

The IDLE state is the normal state where the module both searches for preamble on the RF and wait for a character to be received on the UART. RXD is the state when receiving characters from the host filling up the internal buffer. TX state is when the data is transmitted on the air. RX state is when data is received from the air after preamble detection. TXD is the state where the received data is sent to the host on the UART.

CONFIG is the configuration mode, the state entered by sending 00h or asserting the CONFIG pin and is entered during parameter configuration, while MEMORY CONFIG is the sub-state entered by the 'M' command where the non-volatile configuration memory is being programmed. Note the limitation on maximum number of write cycles using the 'M' command, see Electrical Specifications.

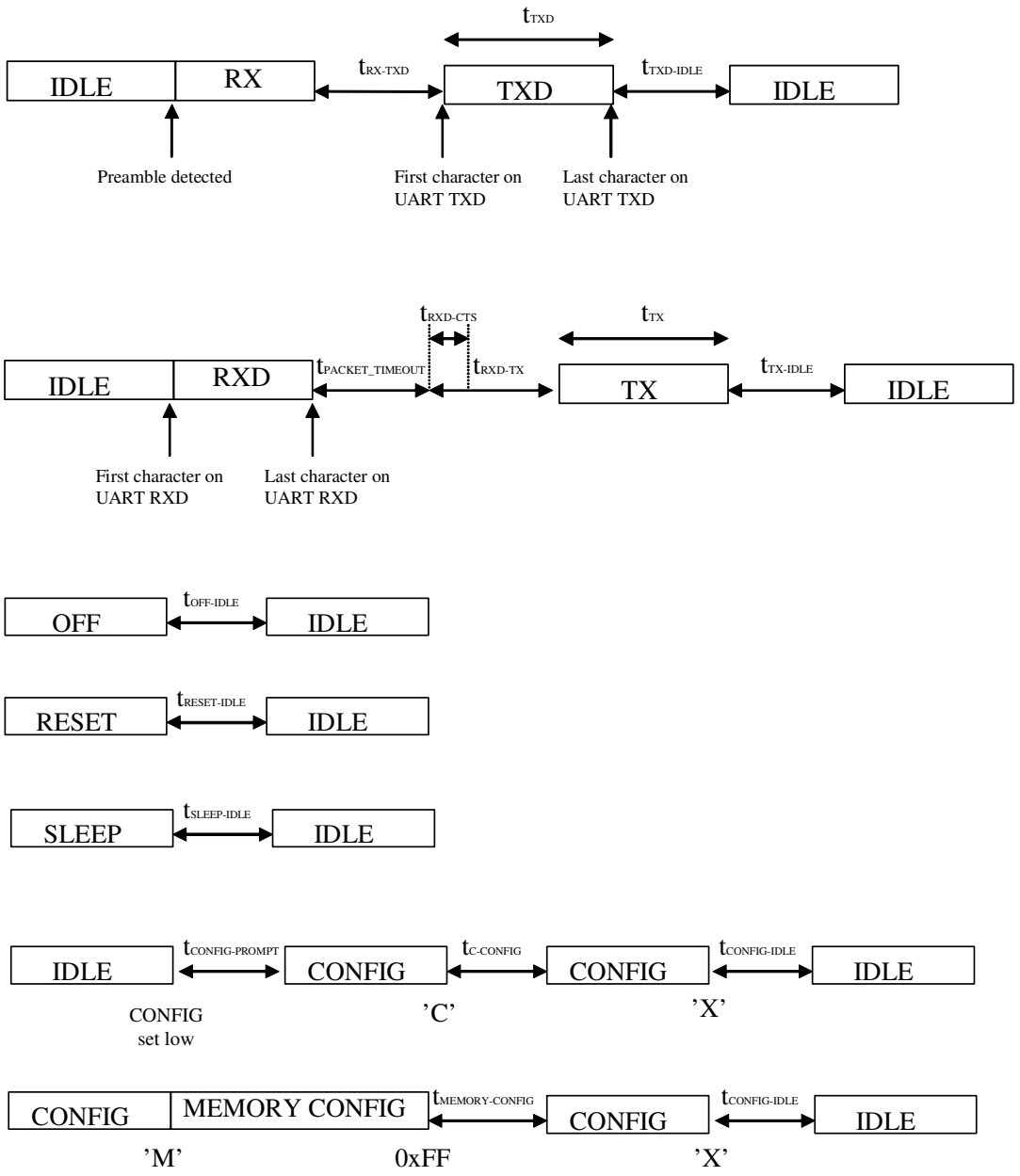

Figure 6: UART timing diagram

Timing values are shown in the timing table for each KNX feature set.

Power Management
The module can be set in SLEEP mode in order to reduce the power consumption.

The low power SLEEP mode is manually entered by using the SLEEP command 'Z' after the module is set in configuration mode. It is also possible to configure the module to enter SLEEP automatically after a message has been transmitted (SLEEP_MODE=1). With this setup the module has to enter TX-mode (transmit a message) after power-on before entering SLEEP mode first time. In SLEEP mode the module will not receive or detect incoming data, neither from the host (UART port) nor from the air. The module is awakened from the SLEEP mode by sending the wake-up byte FFh on the UART RXD line (use a UART Baud rate > 4.8 kBd due to a maximum pulse length requirement). After the module has woken up (see Timing Information) it is ready to receive data on the UART or from the air. The SLEEP command can be used for both Master and Slave.

All configuration settings and RAM values are retained during SLEEP.

If the module is shut completely off (supply power turned off), all configuration settings in non-volatile memory is restored, but values in RAM are overwritten with default settings.

RSSI Reading
The module provide a digital Received Signal Strength Indicator (RSSI) through the 'S' command, or attached to the received messages. The RSSI value appended to a received message is the signal strength of that received packet. The RSSI value is a 8 bit character (one byte) indicating the current input signal strength or the signal strength of the received message. The signal strength can be used as an indication of fading margin, or as a carrier sense signal to avoid collisions.

The RSSI value increases with increased input signal strength in 0.5 dB steps. Input signal strength is given by (typ.):

$$P = - RSSI / 2 \text{ [dBm]}$$

KNX1 Description

The KNX1 support all the basic features of Receiver and Transmitters according to KNX RF 1.1 and KNX Ready specifications. Up to 64 transmitters (unique serial numbers) can be registered in the Receiver.

KNX1 Automatic Sleep
The S1 mode for transmitters only has special support for automatic sleep after data transmission. If automatic SLEEP after TX is enabled (SLEEP_MODE = 1), the module will automatically go to sleep after data transmission.

KNX1 Installation and Binding
The module can be set in a “receive all” Installation Mode using the “I” command. When the module is in the “receive all“ mode it will accept all messages, and can use these to extract addresses for binding.

Transmitters can be bound to a Receiver by registering their addresses in the Address Register. This is done by using the “B” (Bind) command followed by a register number (1-64) and an 8 bytes slave address. The Serial Number address must start with FFh, 00h followed by the 6 address bytes. Note, the Domain Address shall NOT be registerd in the Address Register, as it is configured using the ‘M’ command in the Configuration Memory.

A maximum of 64 Transmitters can be bound to one Receiver.

Note; the host must know which registers are used and which are free at any time.

KNX1 Timing table
The table below shows the timing information for the module when changing between different operating states. Timing symbol is according to figure 5 and 6.

[Table to be updated]

Symbol	Value	Description / Note
t_{RX-TXD}	180 us	Time from last byte is received from the air until first character is sent on the UART
t_{TXD}	Min 590 us	t_{TXD} = # bytes received x 590 us/char (10 bits at 19.2 kBd + 70 us delay per character)
$t_{TXD-IDLE}$	900 us	Time from last character is sent on the UART until module is in IDLE mode (ready for RXD and RX)
$T_{RXD-CTS}$	20 us	Time from last character is received by the UART (including any timeout) until CTS is activated
t_{RXD-TX}	960 us	Time from last character is received by the UART (including any timeout) until the module sends the first byte on the air.
$T_{TX-IDLE}$	960 us	Time from last character is sent on the air until module is in IDLE mode (ready for RXD and RX)
$t_{OFF-IDLE}$	3.2 ms	
$t_{RESET-IDLE}$	3.0 ms	
$t_{SLEEP-IDLE}$	1.3 ms	
$t_{CONFIG-PROMPT}$	60 us	Time from 00h / CONFIG pin is set low until prompt (“>”)
$T_{G-CONFIG}$	1.1 ms	Delay after channel-byte is sent until prompt (“>”).(For other volatile memory commands there is no delay but immediate prompt)
$T_{G-CONFIG}$	1.1 ms	Delay after new M-Bus mode-byte is sent until prompt (“>”).(For other volatile memory commands there is no delay but immediate prompt)
T_{WAIT}	1.55 ms (B, K and M command) 24 us (all other commands)	Delay from stop bit of the command byte to start bit of the prompt reply. See figure 5 for details.
$T_{MEMORY-CONFIG}$	31 ms	In this period the internal flash (non-volatile memory) is programmed. *Do not reset, turn the module off, or allow any power supply dips in this period as it may cause permanent error in the Flash configuration memory. After the last command parameter byte the host should wait for the ‘>’ prompt before any further action is done to ensure correct re-configuration.*
$T_{CONFIG-IDLE}$	1.1 ms	End of ‘X’ to IDLE
t_{TX}	3.6 ms	TX time for T1 mode when Length=1 on the UART. Preamble, sync, CRC and KNX address field added internally. Depends on M-Bus mode (T, S, R) and L

KNX1 Configuration Commands

A list of commands is shown in the table below. Commands must be sent as ASCII characters or their corresponding binary value. All arguments must be sent as binary values to the module (not as ASCII representation for hex or decimal).

Parameter	Command	Argument in hex (decimal)	Note
Bind	'B' – 0x42	Register number (1-64) followed by 8 byte address (NB: First two address bytes must be FFh, 00h)	Used to bind Transmitter to Receiver. Data stored in non-volatile memory.
KNX mode	'G' – 0x47	0x00-0x04 (0-4) 0: S2 3: S1	Data is stored in volatile memory only.
Install	'I' – 0x49	0: Normal operation 2: Accept all messages	
List binding	'L' – 0x4C	Register number (1-64)	Module responds with the address stored in the register (8 bytes)
Memory configuration	'M' – 0x4D	(Address, Data): see list of parameters below. 0xFF exits memory configuration.	Used to enter memory configuration menu. Parameters changed are stored in non-volatile memory.
Output power	'P' – 0x50	0x01-0x05 (1-5)	Data is stored in volatile memory only.
Quality Indicator	'Q' – 0x51	Returns one byte indicating the signal quality of the last received packet	Based on bit errors preamble and synch word
Signal Strength (RSSI)	'S' – 0x53	Returns one byte indicating the signal strength of a detected signal or a valid packet.	If a valid packet has been received when in configuration mode, it will return the RSSI of the last received packet.
Exit command	'X' – 0x58	(none)	Exit to normal operation mode. All changes of parameters take effect.
Sleep mode	'Z' – 0x5A	(none)	Exit sleep mode by sending 0xFF on UART RXD pin
Test mode 0	'0' – 0x30	(none)	List all configuration memory parameters
Test mode 1	'1' – 0x31	(none)	TX carrier
Test mode 2	'2' – 0x32	(none)	TX modulated signal PN9 sequence
Test mode 3	'3' – 0x33	(none)	TX off, RX mode
Test mode 4	'4' – 0x34	(none)	IDLE (TX off, RX off)

Note: ASCII characters are written as 'X', hexadecimal numbers are written like 0x00, and decimal numbers are written like 10 throughout the text. A table of ASCII characters and their respective hex and decimal values are found in the Appendix.

Any invalid command will be ignored and the '>' prompt will be re-sent.

If Test mode 1 or 2 is used, it is important to enter Test mode 3 before exiting the configuration mode ('X') in order to ensure proper operation in normal mode.

Example:
To select RF channel 3, send the follow sequence after asserting the CONFIG line and the '>' prompt is received:

Command	**Hex**	**Response**	**Comment/Note**
Enter	0x00	'>'	Or assert CONFIG pin De-assert CONFIG after '>' prompt
'C'	0x43	'>'	
3	0x03	'>'	Wait for '>' prompt
[A new command could be issued here]			
'X'	0x58	(none)	Module returns to IDLE state

Note that the CONFIG line must be de-asserted after the first '>' prompt was received, but before the 'X' command.

KNX1 Configuration Memory

The table below shows the complete list of configurable parameters stored in non-volatile memory. These values can be changed using the 'M' command. All addresses and arguments must be sent as binary values to the module (not as ASCII representation for hex or decimal).

Parameter	Description	Address hex	Argument dec	Factory setting hex (dec)	Comment
Radio configuration					
RF_POWER	Default RF output power	0x01	1-5	0x05 (5)	See data sheet for output power levels.
KNX_MODE	KNX mode	0x03	0: S2 3: S1	0x00 (0)	Use 'G' command to change value in volatile memory only
SLEEP_MODE	Sleep mode	0x04	0: Disable Sleep 1: Enable Sleep after TX 2: Reserved 3: Enable Sleep after TX and RX 5: As 1 with sleep timeout 5: As 3 with sleep timeout	0x00 (0)	When enabled the module enter Sleep mode after transmission (or reception). Delay set by RX_TIMEOUT If enabled with sleep timeout, the module goes directly to Sleep after a Reset, and to Sleep after TIMEOUT when wakeup from Sleep or exit Config mode.
RSSI_MODE	Append RSSI to received data	0x05	0:Disabled 1: Enabled	0x00 (0)	When enabled the RSSI value is appended to the received data
Radio packet configuration					
PREAMBLE_ LENGTH	Short of long preamble in S mode only	0x0A	0x00 (0): Short 0x01 (1): Long	0x00 (0)	Preamble (header) length. Use long for KNX Ready.
BATTERY_ THRESHOLD	Threshold battery voltage for alarm	0x0B	0x00-0x3F 0: Disable	85	Step size is 30 mV/step, 85 corresponds to 2.5 V. The function is disabled if set to 0.
TIMEOUT	Time before modem clear buffer without transmitting if Buffer size < Length byte (first byte).	0x10	<1-254> 0x01 (1): 32 ms 0x02 (2): 48 ms 0x03 (3): 64 ms 0x7C (124): 2 s 0xF9 (249): 4 s	0x7C	IF SLEEP_MODE=3 the same timeout is used to auto sleep slaves. Modem transmit without timeout when Buffer size = length byte.
Medium access, addressing and network management					
NETWORK_ROLE		0x12	0x00 (0): Transmitter/Receiver 0x01 (1): Reserved 0x10 (2): Reserved	0x00 (0)	
Reserved		0x19		0xFF (255)	
Reserved		0x1A		0x00 (0)	
SERIAL_NUMBER	Serial number, first byte	0x1B	0x00-0xFF (0-255)	0x12 (18)	
SERIAL_NUMBER	Serial number, second byte	0x1C	0x00-0xFF (0-255)	0x34 (52)	
SERIAL_NUMBER	Serial number, third byte	0x1D	0x00-0xFF (0-255)	0x56 (86)	
SERIAL_NUMBER	Serial number,	0x1E	0x00-0xFF	0x78	

	fourth byte		(0-255)	(120)	
SERIAL_NUMBER	Serial number, fifth byte	0x1F	0x00-0xFF (0-255)	0x90 (144)	
SERIAL_NUMBER	Serial number, sixth byte	0x20	0x00-0xFF (0-255)	0x00 (0)	
DOMAIN_ADDRESS	Domain Address, first byte	0x21	0x00-0xFF (0-255)	0x01 (1)	
DOMAIN_ADDRESS	Domain Address, second byte	0x22	0x00-0xFF (0-255)	0x02 (2)	
DOMAIN_ADDRESS	Domain Address, third byte	0x23	0x00-0xFF (0-255)	0x03 (3)	
DOMAIN_ADDRESS	Domain Address, fourth byte	0x24	0x00-0xFF (0-255)	0x04 (4)	
DOMAIN_ADDRESS	Domain Address, fifth byte	0x25	0x00-0xFF (0-255)	0x05 (5)	
DOMAIN_ADDRESS	Domain Address, sixth byte	0x26	0x00-0xFF (0-255)	0x06 (6)	
Data and configuration interface, UART Serial Port					
UART_BAUD_RATE	Baud rate	0x30	0x00: Not used 0x01: 2400 0x02: 4800 0x03: 9600 0x04. 14400 0x05: 19200 0x06: 28800 0x07: 38400 0x08: 57600 0x09: 76800 0x0A: 115200 0x0B: 230400	0x05 (5)	BE CAREFUL IF CHANGING AS HOST MAY LOOSE CONTACT WITH MODULE! Does not take effect until module is re-booted / reset.
UART_FLOW_CTRL	UART flow control	0x35	0: None 1:CTS only 3:CTS/RTS 4:RXTX(RS485)	0x00 (0)	
DATA_INTERFACE	Data interface	0x36	0x00: KNX packet with ID and address 0x01: Application data only 0x02: Reserved 0x03: Reserved 0x04: Add start/stop byte 0x08: Add CRC 0x0C: Add start/stop byte and CRC 0x10: TX complete (00:3Fh)	0x00 (0)	Sets receiver data format. First byte is always packet length (except when using start byte) 0x10 can be combined with the other settings by using 0x11 – 0x1C
FREQ_CAL		0x39		Different for each module.	Found in factory and used by the module to minimise the total frequency tolerance. For firmware upgrade, read back the value and write it back after the upgrade.
LED_CONTROL		0x3A	0: Disabled 1: RX/TX indicator 2: UART/RF IDLE indicator	0x00 (0)	Use to enable LED0/LED1 for RX/TX packet indication or UART/RF IDLE mode indicator.
INSTALL_MODE		0x3D	0: Normal mode	2	

			(accept installed transmitters only) 1: Reserved 2: Filter off (accept all messages)		
PART_NUMBER		0x60-0x6B		RCxxxx-KNX1	
HW_REV_NO		0x6D-0x72		x.yz	x, y and z; Any number 0d-9d
FW_REV_NO		0x74-0x77		x.yz	x, y and z; Any number 0d-9d
MODULE_SERIAL_NUMBER		0xC0-0xC7		All 0x00	8 bytes reserved for serial number for traceability. Is programmed by Radiocrafts during test.
Exit from memory configuration		0xFF	No argument should be sent		To exit from command mode the 'X' command must be sent after '>' is received.

To make permanent changes to default values and other parameters, the Memory Configuration command 'M' is used. This command should be followed by pairs of byte being the memory address and the new value to be stored at that address. In order to exit the Memory Configuration mode, the 'address' 0xFF must be sent, but without any data argument. Then wait for the '>' prompt while the internal memory is re-programmed (See Timing Information for typical delay). To completely exit from command mode, the normal exit command 'X' must be sent.

Example:
To change the DOMAIN_ADDRESS (at address 0x21 and 0x26) and set it to (100,200, …) (0x64,0xC8, …), send the following sequence:

Command	**Hex**	**Response**	**Comment/Note**
Enter	0x00	'>'	Or assert CONFIG pin De-assert CONFIG after '>' prompt
'M'	0x4D	'>'	Module ready to receive address
0x21	0x21	(none)	
100	0x64	(none)	
0x22	0x22	(none)	
200	0xC8	(none)	
[new address could be sent here]			
[new value could be sent here]			
0xFF	0xFF	'>'	Wait for '>' prompt
'X'	0x58	(none)	Module returns to IDLE state

Test mode 0 ('0' command) can be used to list all parameters stored in non-volatile memory. This command can be used to verify and check the module configuration.

Appendix: Configuration Memory Factory Default

Address	KNX1 factory default Values							
0x00-0x07	0x0B	0x05	0x02	0x00	0x00	0x00	0x64	0x00
0x08-0x0F	0x05	0x3C	0x00	0x55	0x00	0x00	0x80	0x80
0x10-0x17	0x7C	0x00	0x00	0x01	0x00	0x00	0x17	0x00
0x18-0x1F	0x00	0xFF	0x00	0x12	0x34	0x56	0x78	0x90
0x20-0x27	0x00	0x01	0x02	0x03	0x04	0x05	0x06	0x04
0x28-0x2F	0xFF	0x08	0x00	0x00	0x00	0x00	0x00	0x00
0x30-0x37	0x05	0x08	0x00	0x01	0x05	0x00	0x00	0x01
0x38-0x3F	0x2B	0x00	0x00	0x44	0x06	0x02	0x00	0x00
0x40-0x47	0xFF	0xFF	0xFF	0xFF	0xFF	0Xff	0xFF	0xFF
0x48-0x4F	0xFF	0xFF	0xFF	0xFF	0xFF	0xFF	0xFF	0xFF
0x50-0x57	0x00	0x00	0x00	0x00	0x00	0x00	0x00	0x00
0x58-0x5F	0x00	0x00	0x00	0x00	0x00	0x00	0x00	0x00
0x60-0x67	0x00	0x52	0x43	0x31	0x31	0x38	0x30	0x2D
0x68-0x6F	0x4B	0x4E	0x58	0x31	0x2C	0x32	0x2E	0x30
0x70-0x77	0x30	0x2C	0x30	0x42	0x30	0x31	0x20	0x00
0x78-0x7F	0xFF	0xFF	0xFF	0xFF	0xFF	0xFF	0xFF	0xFF
0x80-0x87	0xFF	0xFF	0xFF	0xFF	0xFF	0xFF	0xFF	0xFF
0x88-0x8F	0xFF	0xFF	0xFF	0xFF	0xFF	0xFF	0xFF	0xFF
0x90-0x97	0xFF	0xFF	0xFF	0xFF	0xFF	0xFF	0xFF	0xFF
0x98-0x9F	0xFF	0xFF	0xFF	0xFF	0xFF	0xFF	0xFF	0xFF
0xA0-0xA7	0xFF	0xFF	0xFF	0xFF	0xFF	0xFF	0xFF	0xFF
0xA8-0xAF	0xFF	0xFF	0xFF	0xFF	0xFF	0xFF	0xFF	0xFF
0xB0-0xB7	0xFF	0xFF	0xFF	0xFF	0xFF	0xFF	0xFF	0xFF
0xB8-0xBF	0xFF	0xFF	0xFF	0xFF	0xFF	0xFF	0xFF	0xFF
0xC0-0xC7	0xFF	0xFF	0xFF	0xFF	0xFF	0xFF	0xFF	0xFF
0xC8-0xCF	0xFF	0xFF	0xFF	0xFF	0xFF	0xFF	0xFF	0xFF
0xD0-0xD7	0xFF	0xFF	0xFF	0xFF	0xFF	0xFF	0xFF	0xFF
0xD8-0xDF	0xFF	0xFF	0xFF	0xFF	0xFF	0xFF	0xFF	0xFF
0xE0-0xE7	0xFF	0xFF	0xFF	0xFF	0xFF	0xFF	0xFF	0xFF
0xE8-0xEF	0xFF	0xFF	0xFF	0xFF	0xFF	0xFF	0xFF	0xFF
0xF0-0xF7	0xFF	0xFF	0xFF	0xFF	0xFF	0xFF	0xFF	0xFF
0xF8-0xFF	0xFF	0xFF	0xFF	0xFF	0xFF	0xFF	0xFF	0xFF

Grey: Reserved (do not change).
Blue: Reserved for Module part number and version information (do not change). Typical values shown, the actual content of memory in this depends on part number and version number

Appendix: ASCII Table

HEX	DEC	CHR	CTRL
0	0	NUL	^@
1	1	SOH	^A
2	2	STX	^B
3	3	ETX	^C
4	4	EOT	^D
5	5	ENQ	^E
6	6	ACK	^F
7	7	BEL	^G
8	8	BS	^H
9	9	HT	^I
0A	10	LF	^J
0B	11	VT	^K
0C	12	FF	^L
0D	13	CR	^M
0E	14	SO	^N
0F	15	SI	^O
10	16	DLE	^P
11	17	DC1	^Q
12	18	DC2	^R
13	19	DC3	^S
14	20	DC4	^T
15	21	NAK	^U
16	22	SYN	^V
17	23	ETB	^W
18	24	CAN	^X
19	25	EM	^Y
1A	26	SUB	^Z
1B	27	ESC	
1C	28	FS	
1D	29	GS	
1E	30	RS	
1F	31	US	
20	32	SP	
21	33	!	
22	34	"	
23	35	#	
24	36	$	
25	37	%	
26	38	&	
27	39	'	
28	40	(	
29	41	)	
2A	42	*	
2B	43	+	
2C	44	,	
2D	45	–	
2E	46	.	
2F	47	/	
30	48	0	
31	49	1	
32	50	2	
33	51	3	
34	52	4	
35	53	5	
36	54	6	
37	55	7	
38	56	8	
39	57	9	
3A	58	:	
3B	59	;	
3C	60	<	
3D	61	=	
3E	62	>	
3F	63	?	

HEX	DEC	CHR
40	64	@
41	65	A
42	66	B
43	67	C
44	68	D
45	69	E
46	70	F
47	71	G
48	72	H
49	73	I
4A	74	J
4B	75	K
4C	76	L
4D	77	M
4E	78	N
4F	79	O
50	80	P
51	81	Q
52	82	R
53	83	S
54	84	T
55	85	U
56	86	V
57	87	W
58	88	X
59	89	Y
5A	90	Z
5B	91	[
5C	92	\
5D	93	]
5E	94	^
5F	95	_
60	96	`
61	97	a
62	98	b
63	99	c
64	100	d
65	101	e
66	102	f
67	103	g
68	104	h
69	105	i
6A	106	j
6B	107	k
6C	108	l
6D	109	m
6E	110	n
6F	111	o
70	112	p
71	113	q
72	114	r
73	115	s
74	116	t
75	117	u
76	118	v
77	119	w
78	120	x
79	121	y
7A	122	z
7B	123	{
7C	124	|
7D	125	}
7E	126	~
7F	127	DEL

Document Revision History

Document Revision	Changes
1.0	First release

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